RAVE: Relative Aquifer Vulnerability Evaluation

An on-farm scoring system to evaluate aquifer vulnerability to pesticide contamination

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MDA Technical Bulletin 90-01

Introduction

Farmers and pesticide applicators of today are faced with growing concern over the potential for pesticide contamination of groundwater. Over 50% of all Montanan's and 95% of the agricultural community consume groundwater as their source of drinking water. Protecting this fragile resource from pesticide contamination is imperative, because some pesticides may be harmful to humans at very low concentrations and clean-up of groundwater is extremely difficult. Pesticide residues in groundwater may also adversly affect sensitive crops and wildlife.

To help farmers and pesticide applicators reduce the potential for contaminating groundwater with pesticides, an aquifer vulnerability scoring system; Relative Aquifer Vulnerability Evaluation (RAVE) has been developed. This numeric scoring system helps individuals evaluate pesticide selection for on-site groundwater contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application required in all situations.

In many cases pesticide contamination of groundwater can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors in a particular area determine the relative vulnerability of groundwater to pesticide contamination. Nine of these factors have been incorporated into the RAVE score card (Page 3) and are defined below. A value for most of these factors can be determined by a simple on-site inspection. If a value for a particular factor is not known, then the appropriate agency should be contacted. A listing of agency contacts is provided below. Pesticide leaching potential is based on the persistence and mobility of a pesticide in the soil. A list of leaching potentials for some commonly used pesticides is given on page 4.

Factor Definitions

Cropping Practice: Is the field being rated flood, sprinkler or non-irrigated.

Depth to Groundwater: Distance in vertical feet below the soil surface to the water table.

Distance to Surface Water: Distance in feet from field boundary to the nearest flowing or stationary surface water.

Percent Organic Matter: The relative amount of decayed plant residue in the soil (see soil test results, county soil survey or consult SCS). May be estimated by soil color; darker soil generally indicates higher organic matter (most Montana soils are less than 3%).

Pesticide Application Frequency: Number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: Whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate groundwater based upon the persistance and mobility of the pesticide.

Topographic Position: Physical surroundings of the field to which the pesticide appliction is to be made. Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling uplands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

Sources of Information

Soil Information: (1) USDA-SCS soil survey, district offices in most county seats, (2) Montana State University (MSU) Extension Service in most county seats, State Soil Specialist in Bozeman (994-4601). (3) MSU Department of Plant and Soil Science (994-4601).

Groundwater Information: (1) Montana Bureau of Mines and Geology in Butte (496-4155) in Billings (657-2938). (2) United States Geological Survey in Helena (449-5225), (3) Montana Department of Health and Environmental Sciences (444-3948). (4) Montana Department of Natural Resources and Conservation (444-6873).

Pesticide Information: (1) Montana Department of Agriculture Environmental Management Division, headquarters in Helena (444-2944), regional offices in Billings (652-3615), Bozeman (587-9067), Great Falls (761-0926), in Glasgow (228-9510), Missoula (549-9678). (2) MSU Extension service offices in most county seats, pesticide specialist in Bozeman (994-3518). (3) US EPA Montana Office in Helena (449-5432).

Directions for Use of the RAVE Score Card

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper write down the appropriate value for each of the nine factors listed on the score card. For example; at a sprinkler irrigated site the "Cropping Practices Factor" would be assigned a value of 7. Once all of the factors have been assigned a value, the values should be totaled. This total should then be compared to the Score Card Interpretation Scale to determine the relative vulnerability of groundwater to contamination by an individual pesticide. Higher scores indicate higher vulnerability of groundwater to pesticide contamination. If a high score is received, select an alternative pesticide and compare the results.

Score Card Interpretation Scale:

30	60	100
Low Concern		High Concern

THE RAVE SCORE CARD

DEPTH TO GROUNDWATER :
*2- 10 ft 20
10- 25 ft 12
25-50 ft 5
>50 ft 0 ____

SOIL TEXTURE:
Gravelly 15
Sandy 15
Loamy 10
Clayey 5 ____

PERCENT SOIL ORGANIC MATTER:
0 -1% 5
**1-3% 3
>3% 2 ____

TOPOGRAPHIC POSITION:
Floodplain 15
Alluvial bench 10
Rolling foothill 5
Upland plain 2 ____

DISTANCE TO SURFACE WATER:
0-100 ft 5
100-500 ft 3
>500 ft 2 ____

CROPPING PRATICE:
Flood irrigated 10
Sprinkler Irrigated 7
Non-irrigated 2 ____

PESTICIDE APPLICATION FREQUENCY:
>1/year 5
1/year 2 ____

PESTICIDE APPLICATION METHOD:
Soil Applied 5
Foliar applied 2 ____

PESTICIDE LEACHING INDEX:
***High 20
Moderate 10
Low 5 ____

Total All Rankings for the field and pesticide in question here: _____ =RAVE SCORE

*** If watertable is less than 2 feet deep then applications should probably not be made**
****If unknown use this value.**
*****See Table 1 for leaching index for the pesticide in question.**

Interpretation of RAVE Scores

The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of groundwater to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for groundwater contamination. In such instances alternative pesticides should be sought which have a lower leaching potential. Scores of 80 or greater indicate that pesticide applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 65 indicate a moderate to low

potential for groundwater contamination and scores less than 45 indicate a low potential for groundwater contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect groundwater.

Table 1. Commonly used pesticides, an example trade name and relative pesticide leaching potentials

Pesticide	Leachability	Pesticide	Leachability
Insecticides		Herbicides	
acephate (Orthene)	high	acifluorin (Blazer)	low
aldicarb (Temik)	high	alachlor (Lasso)	high
azinphos-methyl		amitrol	high
(Guthion)	low	atrazine	high
carbaryl (Sevin)	low	barban (Carbyne)	low
carbofuran (Furadan)	high	bentazon (Basagran)	low
chlorpyrifos (Lorsban)	low	bromoxynil (Butricil)	mod
diazinon	mod	chloramben (Amiben)	high
dimethoate (Cygon)	high	chlorsulfuron (Glean)	high
disulfoton (Di-syston)	low	clopyralid (Stinger)	high
endosulfan (Thiodan)	low	cyanazine (Bladex)	high
esfenvalerate (Asana)	low	cycloate (Ro-Neet)	low
fonofos (Dyfonate)	low	dalapon	high
malathion	low	diallate (Avadex)	low
methamidophos		dicamba (Banvel)	high
(Monitor)	high	difenzoquat (Avenge)	low
methyl Parathion	low	DPX-M6316 (Harmony)	high
parathion	low	EPTC (Eptam)	low
permethrin (Ambush)	low	enthalfuralin (Sonalan)	low
phorate (Thimet)	low	fenoxaprop (Whip)	low
terbufos (Counter)	low	fluzifop-P (Fusilade)	low
trichlorfon (Dylox)	high	glyphosate (Roundup)	low
		MCPA	high
Fungicides		metribuzin (Sencor)	high
benomyl (Benlate)	low	metsulfuron (Ally)	high
chlorthalonil (Bravo)	high	paraquat (Gramoxone)	low
copper hydroxide		pendimethalin (Prowl)	low
(Kocide)	low	picloram (Tordon)	high
maneb	low	propanil (Stampede)	mod
mancozeb (Dithane)	low	sethoxydim (Poast)	low
metalaxyl (Ridomil)	mod	simazine (Princep)	mod
propiconazole (Tilt)	low	triallate (Far-Go)	low
sulfur	low	trifluralin (Treflan)	low
triadimefon (Bayleton)	low	2,4-D	high
		2,4-DB	high

Adapted from McBride et al. 1989.